casional showers fell along the coast, and light sprinkles in the eastern part of the state.

Winds.—The winds were generally light to fresh from a westerly direction.

Frosts.—Occasional frosts are reported at Fort Klamath from the 11th to 25th, and a very light frost at Baker City on the 13th. At East Portland light frost occurred from the 10th to 14th, inclusive. Frosts occurred in the mountain regions or along the foot hills from 12th to 17th; they were light and no damage is reported. Frost in July is unusual.

The "South Carolina Weather Service," Hon. A. P. Butler, Commissioner of Agriculture for South Carolina, director:

The month has been chiefly remarkable for the unusually high temperature which prevailed during the second decade, and for the abundant rains which occurred during the closing days.

The temperature began to rise on the 12th, on which date Hampton and Bennettville reported maximum readings of 100° each. On the following day, 13th, the maxima were: Hampton, 103°; Bennettsville, 101°; Brewer Mine, 100°; and Chester, 104°. The temperature continued to increase over all sections of the state until the 18th and 19th, on which dates the highest temperatures of the month were reported.

At Charleston the mean temperature, 81°.7, was slightly below the average of the last sixteen years. In the rest of the state it was normal or slightly above.

The heavy rains of the 29th and 30th were caused by the passage of a cyclone which formed in the Gulf of Mexico prior to the 27th; on that date it was central near Pensacola, Fla., whence it moved north-northeastward into Alabama. From the 29th until the 31st the cyclonic area increased and spread over Alabama, Georgia, South Carolina, and northern Florida, and was attended by heavy rains, with tornadoes, in Alabama, Georgia, and our state.

Summary.

Mean temperature for the state, 82°; highest temperature, 110°, at Chester, on the 18th; lowest temperature, 60°, at Spartanburg on the 1st and 3d; range of temperature, 50°; greatest daily range of temperature, 39°, at Spartanburg, on the 1st; least daily range of temperature, 2°, at Newberry, on the 29th.

Mean depth of rainfall, 7.49 inches; greatest monthly rainfall, 13.62 inches, at Blackville; least monthly rainfall, 2.79 inches, at Jacksonborough; greatest daily rainfall, 3.70 inches at Abbeville on the 30th; least daily rainfall, trace (amount inappreciable), at Spartanburg and Abbeville on the 18th, and at Anderson and Hampton on the 19th.

Average number of rainy days, 14.4.

The following is an extract from the report of the "Meteorological Department of the State (Tennessee) Board of Health," prepared under direction of J. D. Plunkett, M. D., President of the State Board of Health, by H. C. Bate, Signal Corps, Assistant, Nashville:

The month of July presented the usual amount of electrical disturbances, but the principal feature was the excessive and unprecedented heat during the latter half of the month.

The mean temperature was 78°.8, considerably above the normal, and the highest mean for many years. The minimum was 56° recorded on the 1st, and was the highest July minimum since 1883. The hot wave which came about the 10th, culminated generally about the 17–19th, but continued with a slight relaxation until the close of the month, and was the longest warm spell ever known. The ranges of temperature were about the normal.

The precipitation was rather below the average, the mean being 3.32 inches; of this amount, the eastern division received an average of about four inches, and the other two divisions about three inches. The week of the 14–20th was the "dry week," and with the exception of a few local rains in east Tennessee, and two or three in the western part of the state, there was a serious absence of precipitation. It was during this period that the hot wave culminated and was so severely felt. Many of the rains were attended with severe electric storms, some of which were very destructive to life and property. The proportion of cloudiness was about the normal.

Summary.

Mean temperature, 78°.8; highest temperature, 101°, on the 18th and 30th, at Milan, and on the 29th, at Austin; lowest temperature, 56°, on the 1st, at Farmingdale; range of temperature, 45°; mean monthly range of temperature, 31°.1; greatest monthly range of temperature, 42°, at Farmingdale; least monthly range of temperature, 25°, at Waynesborough; mean daily range of temperature, 15°.8; greatest daily range of temperature, 32°, on the 1st and 19th, at Farmingdale, and on the 18th, at Hohenwald; least daily range of temperature, 2°, on the 6th, at Rogersville, and on the 24th, at Beech Grove; mean of maximum temperatures, 98°.0; mean of minimum temperatures, 66°.8.

Average number of clear days, 11.3; average number of fair days, 11.5; average number of cloudy days, 8.2; average number of days on which rain fell, 11.5.

Mean depth of rainfall, 3.32 inches; mean daily rainfall, 0.107 inch; greatest rainfall, 5.67 inches at Grief; least rainfall, 0.80 inch, at Woodstock; greatest local daily rainfall, 2.13 inches, on the 24th, at Florence Station.

Days of greatest rainfall, 4th, 5th, 6th, 7th, 21st, 24th; day of greatest rainfall, 24th; day without rainfall, 15th.

Warmest days, 19th, 30th, 31st; coldest day, 1st.

Prevailing winds, south and southwest.

NOTES AND EXTRACTS.

COINCIDENCE OF SUN SPOTS WITH THUNDER-STORMS AND AURORAS.

The following extract is published in view of the general interest in sunspot investigations:

As the result of the extended series of observations described, it has been found in general that whenever groups of faculæ, with or without dark spots, are appearing by rotation or are bursting forth upon the earthward side of the sun there is an immediate increase in thunder-storms in the lower latitudes, and probably of auroras in the higher latitudes. If, however, the aurora becomes visible nearer the equator at such times, there is an immediate, though perhaps temporary, decrease in thunder-storms, as though the aurora had taken their place. In short, the aurora and thunder storms appear to have a common origin, and in certain localities, at least, a reciprocal relation to each other. Instances have been noted also in which an aurora in the United States has been coincident with unusual electrical storms in Europe, and vice versa.

The relation between the various phenomena is such that if an increase of thunder-storms or auroras is noted, faculæ coming into view by rotation or bursting forth elsewhere upon the sun may be looked for with confidence. On the other hand the appearance upon the sun of bright faculæ betokens an immediate increase in the electrical phenomena attending the storms which may be prevailing at the time anywhere on the face of the earth, unless an aurora should intervene, as has already been noted.

In general the disturbed solar and terrestrial conditions increase or diminish in like ratio. The curious fact has been noted, however, that a single disturbance occupying the sun's disc alone seems to have a more marked effect than a succession of such disturbance as though variability of tension rather than the maintenance of high tension were most concerned in the production of the phenomena in question. Aside from this, and as a rule, however, there is an evident proportion between the extent of the disturbances on the sun and those on the earth. Neither auroras nor thunder-storms become universal, but are distributed in accordance with laws which it is not proposed to discuss at present. The point is that under known limitations and in definite localities there is an increase in these phenomena whenever the solar conditions are favorable, and no such increase has been noted at any other time.

As is the case with auroras and thunder-storms, the disturbances of earth currents, known as magnetic storms, are subject to limitations and do not prevail with equal intensity at any one time over the entire surface of the globe.

The forces manifest in thunder-storms and auroras being of the character and having the origin that has been described, the question arises as to whether these forces are concerned also in the production of the movements of the atmosphere with which they are associated. (By M. A. Veeder, in The Electrical World, Vol. X. No. 9.)

EFFECT OF RAINFALL UPON TEMPERATURE OF THE AIR.

From Saturday, July 16th, to Sunday, July 24th (both inclusive) there fell 7.3 inches of rain, as measured in a rain-gauge at my residence on the Ridgewood Road, Maplewood, situated about one-third up the slope of the Orange Mountain, and exactly fourteen miles due west from New York City. There are 43,560 square feet on an acre; and 7.3 inches equals 0.608 of a foot; 43,560 x 0.608 equals 26,484 cubic feet to the acre. * * * Now it has been determined by accurate experiments, that if we could put all the heat given out by the burning of twenty pounds of dry white pine into a cubic foot of water, it would convert the water entirely into vapor, having the ordinary temperature (say 60°) of the air.

When vapor condenses into water, the heat which kept it as vapor must evidently go out from it. The data gives us some curious figures. As we had a fall of 26,484 cubic feet to the acre, it would require 20 x 26484, or 529,680 pounds of dry pine wood to send this mass of water again into vapor. A cord of dry white pine is said to weigh 1,868 pounds, and 529,680 divided by 1,868 gives 283 cords as the quantity of pine wood required, in burning, to evaporate our recent rainfall on an acre; and before that rain could fall on the acre, just as much heat as is given out in the burning of 283 cords of pine wood had to be lost to the vapor and given out to the air above us. Should we be surprised that a fall of rain (except it be very cold) rarely cools the air? [A. M. Mayer, in Scientific American, No. 6, vol. lvii.]

The above extract will be of interest in connection with the consideration of rainfall as a modifier of high summer temperatures. It should be remembered that the heat liberated by condensation is usually at quite an elevation above the earth surface, and its influence upon the surrounding air will generally cause it to rise instead of falling to the earth. At the same time the stratum of air next to the earth is being charged by vapor produced from the rainfall coming in contact with the heated earth. This evaporation will cause a large amount of heat to be taken up and will correspondingly reduce the temperature of the earth surface.

NORTH ATLANTIC STORMS DURING 1885.

[By Sergeant E. B. GARRIOTT, Signal Corps.]

It is intended to herein show the characteristics of the storms that appeared over the north Atlantic Ocean during 1885, with particular reference to their direction of movement, *rate of progress*, and the extent of territory they traversed, as shown by the storm-track charts and accompanying text published with the MONTHLY SUMMARY AND REVIEW OF INTERNATIONAL METEOROLOGY. The causes which contributed to abnormal movements of storm-areas over the ocean will also be considered, as determined by daily charts containing the data of simultaneous, international observations furnished by shipmasters. Before entering upon a discussion of this subject it is pertinent to state that it is a common belief that a large percentage of the storms which leave the American coast travel across the Atlantic and affect the weather conditions of western Europe. In this connection the storm-track charts show that of the sixty storms which advanced over the ocean from the American continent during the year, twenty-eight, or nearly 47 per cent. were traced to European waters. During the same period fifty-nine storms developed, or first appeared, over the ocean, of which about 65 per cent. were traced to the west coast of Europe.

The general direction assumed by storm-areas in the middle latitudes was east-northeast, and the average time occupied in crossing the ocean was four and six-tenth days; these averages holding good for each month of the year, except March, August, and October, when no storms traversed the ocean from coast to coast.

The *direction of movement* was due principally to the relative positions of the permanent area of high pressure which occupied the ocean south of the fortieth parallel, and the area of low pressure which appeared each month to the northward of the fiftieth parallel, the monthly positions of which, together with the mean barometric pressures as shown by the encircling isobars, being given in the following table:

Month.	Positions of centres of mean high barometer areas. Latitude.	Longitude.	Barometric pressure.	Positions of centres of mean low barometer areas. Latitude.	Longitude.	Barometric pressure.
1885.			*Inches.*			*Inches.*
January	N. 30	W. 55	30.20	N. 60	W. 30	29.50
February	25	38	30.10	60	10	29.40
March	40	30	30.30	70	E. 10	29.60
April	35	30	30.20	55	W. 20	29.70
May	30	35	30.10	60	0	29.80
June	35	30	30.20	65	20	29.80
July	38	28	30.30	65	30	29.80
August	30	40	30.10	65	20	30.00
September	35	30	30.20	65	20	29.60
October	40	25	30.20	60	E. 5	29.70
November	30	40	30.10	55	W. 30	29.60
December	45 30	0 40	30.20 30.10	70	E. 20	29.40

This table, in showing the relative positions of mean high and low barometer areas, verifies the fact that areas of low pressure, as a rule, take a north of east course along the west and north margins of high barometer areas, and advance to localites where the barometric pressure is least. It also shows that in March and October, when no storms traversed the ocean, the area of mean high pressure was located over *mid-ocean in unusually high latitudes*, and that during August the pressure was uniformly high over the entire ocean, and no area of relatively low mean pressure appeared in high latitudes, thus explaining why, in March and October, the storm-areas moved northward before reaching European waters, and in August why, in the absence of a mean low-area in high latitudes and the presence of unusually high average pressure along the middle latitudes, the storm-areas did not move eastward.

The flow of the Gulf Stream also seems to contribute to the normal direction of storms on the Atlantic, and it is found that here, as over other portions of the globe, cyclonic areas are inclined to follow the courses of warm ocean currents. These apparent causes, together with the earth's form and motion, seem to occasion the normal direction of storms over the Atlantic in the vicinity of the trans-Atlantic ship routes.

As regards the rate of progress of storms it may be generally stated that this feature, while depending largely upon the energy possessed *by a storm* upon leaving the coast seems to depend to a greater extent upon the barometric conditions which exist over the ocean to the eastward. Storm-areas do not pass through high barometer areas, and their forward movement is showed to be barred by areas of high pressure. During the annual movement of the Arctic ice fields over the Banks of Newfoundland the rates of progress as well as the direction of storms in that vicinity are greatly diversified, and while they acquire great energy in that region, a large proportion disperse over mid-ocean. These characteristics may be accounted for by the presence in that locality during the ice season of marked ranges in atmospheric temperature and humidity upon which a storm's strength is dependent, and a comparative absence of these conditions over the ocean to the eastward, whence the storm-areas are apparently forced by high barometer areas advancing from the westward. It would appear, therefore, that a storm's movement, both as regards speed and direction, depends upon its position relative to high barometer areas; its strength, and its position with reference to the warm ocean currents.

The extent of territory traversed by an ocean storm seems to depend not alone upon the conditions above mentioned, but also upon the region wherein it is first developed. It is shown that storms that originate in sections where the elements of their strength were well defined, exhibit a rapid loss of energy after leaving those regions. This fact may be illustrated by the cyclones peculiar to the West Indies during the summer season, which originate near the limits of the belt of equatorial rain and calm and move westward over the Carribbean Sea along the surface of the warm equatorial current and then circle slowly northward and eastward to colder latitudes, where they gradually lose energy and dissipate. It is noticeable that but an insignificant proportion of the storms which advance from southern latitudes cross the Atlantic in the vicinity, or to the northward, of the trans-Atlantic ship routes, and it is equally observable that, as a rule, the storms which do traverse the ocean leave the coast north of the fortieth parallel.

In summing up the above facts it would appear that a knowledge of the barometric conditions over mid-ocean would *be necessary to foresee the probable* course of a storm leaving the American coast, and that high pressure, north of the fortieth parallel, would prevent a storm from reaching European waters. The changes in position of the permanent area of high barometer which usually occupies the ocean in the vicinity of the Azores are exceedingly slow, and its change of location to more southern latitudes could not be safely calculated upon following its northward movement. It would also appear that the barometric gradient between the regions of high and low pressure *constitutes an important* factor in calculating the movement of ocean storms, and that storms move toward the region of permanent low pressure. It is also shown that storms of tropical or sub-tropical origin are not calculated to flourish in middle or northern latitudes, and finally that, with conditions over the ocean favorable to their passage, the storms of marked strength which leave the American continent, north of the fortieth parallel, are the ones most likely to affect the weather conditions of Europe. As only forty-seven per cent. of the storms traced during the year from the American coast crossed the ocean, it will be seen that the disturbances which occur in European waters are more generally due to storms which develop over the ocean, sixty-five per cent. of which were traced to Europe.

MEAN TEMPERATURE FROM MAXIMUM AND MINIMUM THERMOMETERS.

Observations of the temperature, taken at hourly intervals, will no doubt furnish a satisfactory basis upon which to construct a mean temperature for for any period. The want of satisfactory registering instruments for recording the temperature for each hour or moment of the day, and the time and expense of making personal hourly observations, makes it impracticable to obtain means at all points from hourly readings. A daily mean, computed from various intermediate observations, has been found satisfactory for purposes of climatology. Of these, a mean of observations made at 7 a. m., 2 p. m., and 9 p. m., or at 7 a. m., 3 p. m., and 11 p. m., have given good results. There are many amateur or voluntary observers who find it inconvenient to even take observations at these hours, and important temperature results from their localities are not available. If such observers can take a single daily reading of registering maximum and minimum thermometers their observation could be used to good advantage for constructing mean temterature. A mean of these two daily readings gives a satisfactory mean temperature for the day. The following table gives a comparison of monthly means obtained at a number of stations from observations taken during the year 1885, at 3 a. m., 7 a. m., 11 a. m., 3 p. m., 7 p. m., and 11 p. m., and means of the daily maximum and minimum temperature. An examination of the table will show that the difference between the two means is scarcely appreciable, with a few exceptions. The discrepancy in annual means for three of the five stations given, viz.: Boston, Buffalo, and Washington is only .°3; for Cincinnati it is .°4; and Chicago, .°5; the mean of the maximum and minimum temperatures being higher at all stations.

Month.	Boston. Mean of six observations.	Boston. Mean of daily maxima and minima.	Buffalo. Mean of six observations.	Buffalo. Mean of daily maxima and minima.	Chicago. Mean of six observations.	Chicago. Mean of daily maxima and minima.	Cincinnati. Mean of six observations.	Cincinnati. Mean of daily maxima and minima.	Washington. Mean of six observations.	Washington. Mean of daily maxima and minima.
	°	°	°	°	°	°	°	°	°	°
January	27.2	27.4	20.5	21.0	18.2	18.6	25.9	26.0	33.1	33.7
February	20.5	20.6	13.6	14.6	16.8	17.8	23.2	23.4	26.7	27.0
March	27.9	27.6	19.9	20.4	30.1	31.3	33.4	34.8	34.6	34.8
April	46.7	47.4	39.6	40.7	45.5	46.3	53.0	53.6	53.5	53.6
May	52.4	53.2	53.1	53.8	53.2	53.4	62.2	62.0	62.4	62.4
June	66.6	66.7	61.5	60.8	65.6	65.4	70.2	70.4	71.3	71.3
July	71.4	71.8	70.5	70.0	73.1	73.2	78.0	78.0	78.0	78.4
August	67.4	67.8	65.5	65.0	68.4	68.4	72.7	73.0	73.5	73.9
September	59.9	60.2	61.0	60.2	64.2	64.4	66.0	66.4	66.4	66.6
October	51.4	51.6	49.9	50.0	51.3	51.6	52.6	53.0	55.0	55.4
November	43.7	44.0	40.7	41.1	42.0	42.7	43.7	44.2	45.5	45.4
December	32.8	32.6	30.1	31.1	31.1	31.8	34.9	35.3	37.4	38.1
Annual mean	47.3	47.6	43.8	44.1	46.6	47.1	51.3	51.7	53.1	53.4